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CIRCULAR NO. 18, SECOND SERIES. (REVISION OF NO. 14.)

United States Department of Agriculture,

DIVISION OF ENTOMOLOGY.

THE MEXICAN COTTON-BOLL WEEVIL.

(*Anthonomus grandis* Boh.)

SCOPE OF THE CIRCULAR.

Circular No. 6 was published in April, 1895, and contained a brief report of the observations made up to that time, and the conclusions based on those observations, concerning the Mexican cotton-boll weevil, an insect of Central American origin which, during 1894, attracted considerable attention in the cotton fields of south Texas. The investigation was continued during the summer, fall, and early winter of 1895, especially by Mr. Schwarz, who visited Texas in May and June and again from October to December, and by Mr. Townsend, who was stationed in the State during the greater part of the summer. The writer went to Texas in December, and in company with Mr. Schwarz carefully studied the condition of affairs at that season and talked with many prominent cotton growers. The results of these supplementary investigations were published in Circular No. 14, which was issued both in English and in Spanish. During 1896 still other investigations were made by the gentlemen mentioned and by Mr. C. L. Marlatt, who studied especially the question of remedies, and the results obtained necessitate the publication of still another circular on the subject. In this circular all of the essential points of the previous circulars have been repeated, the section on remedies has been entirely rewritten, and a paragraph has been added on the work of the weevil during 1896.

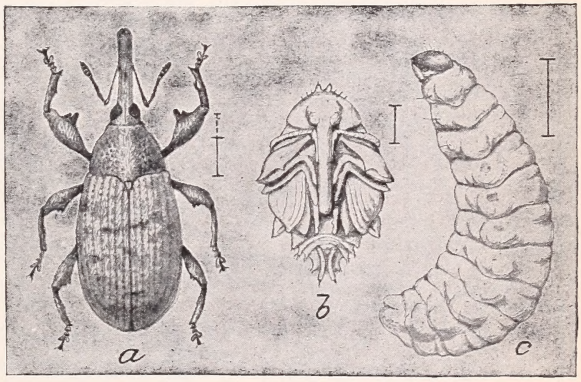

FIG. 1.—*Anthonomus grandis: a*, adult beetle; *b*, pupa; *c*, larva—all enlarged.

GENERAL APPEARANCE AND METHOD OF WORK.

This insect is a small, grayish weevil, of the shape and general appearance shown in fig. 1, *a*, and measuring a little less than a quarter of an inch in length. It is found in the cotton fields throughout

the season, puncturing and laying its eggs in the squares and bolls The larvæ, of the shape and appearance shown at fig. 1, *c*, and measuring a little over three-eighths of an inch in length when full grown live within the buds and bolls and feed upon their interior substance The squares attacked usually drop, but most of the damaged bolls remain upon the plant and become stunted or dwarfed, except late in the season, when they either dry or rot.

DISTRIBUTION.

This insect through its ravages caused the abandonment of cotton culture around Monclova, Mexico, about 1862. Two or three years ago

FIG. 2.—Map showing distribution of the Mexican cotton-boll weevil.

cotton was again planted in that vicinity, but the weevil immediately reappeared and destroyed the crop. At Matamoras the weevil was noticed eight or ten years ago. About 1893 it crossed the river at Brownsville, and in 1894 was noticed in the country around San Diego, Alice, and Beeville. At the close of the season of 1894 the insect occupied a territory extending to the north a little beyond Beeville, a few miles to the east of that point, and southwest to the neighborhood of Realitos, on the National Mexican Railway. The greatest damage seems to have been done along the lower Nueces River. During 1895,

and particularly in the latter part of the season, it extended its range to a considerable extent. Toward the east it was found in moderate abundance along the valley of the Guadaloupe River at Victoria, Thomaston, and Cuero. North of its old range it extended to Kenedy, Floresville, and many points in the country lying between the latter place and Cuero. A single field was found near San Antonio which contained weevils in large numbers, and in the same way a single field was found far to the east at Wharton in which the weevils had appeared late in the season. The exact localities where the insect was found during 1895 are indicated on the accompanying map.

WORK OF THE WEEVIL IN 1896.

It was feared that during 1896 there would be a further spread of the weevil, but for some reason, probably on account of the severe midsummer drought, there was not only no spread beyond the limits indicated on the 1895 map, but, on the contrary, a shrinkage of the territory infested. The main spread in 1895 took place in the autumn and at the outer boundaries, as at San Antonio and at Wharton the weevil was unquestionably killed by the winter frosts. In a field, for example, near San Antonio, which was several times examined in 1895 by Mr. Schwarz, Mr. Townsend, and by the writer, and in which the weevil was extremely abundant down to the month of December, not a trace of the insect could be found in 1896. In 1896 the drought prevented the "make" of the top crop at many points, and there was little food for the autumnal generations of the weevil, and therefore a lesser spread from the localities of successful hibernation.

NATURAL HISTORY AND HABITS.

The insect passes the winter in the weevil state. It can be found on the cotton plant until late in December, and, in fact, as long as any portion of the plant is green. It is found most abundantly in the early winter hidden between the involucre and the boll, and later it frequently works its way down into the dry and open bolls. All the specimens found by Mr. Schwarz in such situations in the late spring of 1895 were dead; but Mr. Townsend found a few living in March. The dry boll is probably not a frequently successful hibernating place. Judge S. G. Borden, of Sharpsburg, however, writing under date of January 27, 1896, states that the weevil at that time was being found nearly every day in the dry bolls; but this statement lacks the significance which it might otherwise have had as bearing on the question of hibernation from the fact that no heavy frost had probably occurred up to that time at Sharpsburg.

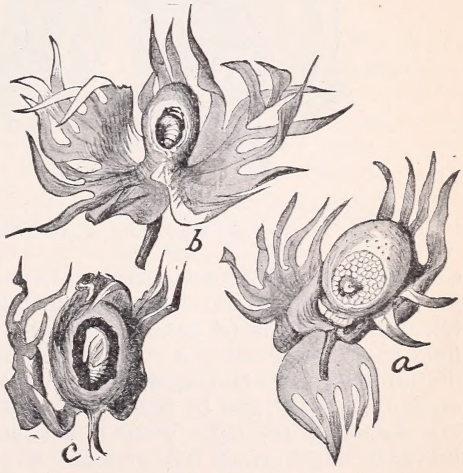

FIG. 3.—*a*, newly hatched larva in young square; *b*, nearly full-grown larva *in situ*; *c*, pupa in young boll picked from ground.

With the cutting of the plants or with the rotting or drying of the bolls as a result of frost, the adult weevils leave the plant and seek shelter under rubbish at the surface of the ground, or among weeds and trash at the margin of the fields. Here they remain until the warm days of spring, when they fly to the first buds on such volunteer plants as may come up in the neighborhood. They feed on these and lay their eggs on the early squares, and one, or perhaps two, generations are developed in such situations, the number depending upon the character of the season and the date of cotton planting. By the time the planted cotton has grown high enough to produce squares the weevils have become more numerous, and those which have developed from the generation on volunteer cotton attack the planted cotton, and through their punctures, either for feeding or egg-laying, cause a wholesale shedding of the young squares. It seems to be an almost invariable rule that a square in which a weevil has laid an egg drops to the ground as a result of the work of the larva; in the square on the ground the larva reaches full growth, transforms to pupa, and issues eventually as a beetle, the time occupied in this round approximating four weeks. Later, as the bolls form, the weevils attack them also, and lay their eggs in them, and the larvæ develop in the interior just as with the squares. The bolls, however, do not drop. Fig. 3, *a* and *b*, show the larvæ in the squares, and *c*, a young boll cut open and the pupa in its customary position.

There is a constant succession of generations from early spring until frost, the weevils becoming constantly more numerous and the larvæ

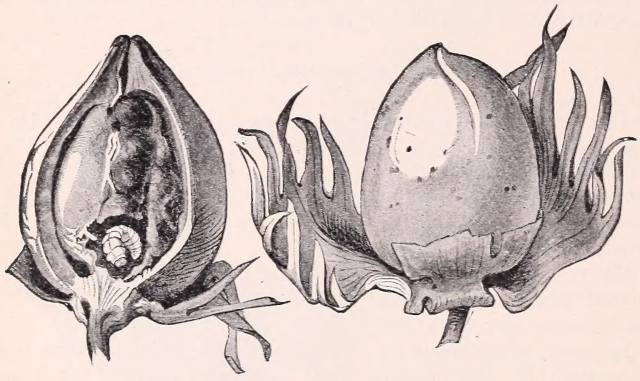

FIG. 4.—Mature boll cut open at left, showing full-grown larva; the one at the right not cut, and showing feeding punctures and oviposition marks.

and pupæ as well. A single female will occupy herself with egg-laying for a considerable number of days, so that there arises by July an inextricable confusion of generations, and the insect may be found in the field in all stages at the same time. The bolls, as we have just stated, do not drop as do the squares, but gradually become discolored, usually on one side only, and by the time the larva becomes full grown generally crack open at the tip. While in a square one usually finds but a single larva, in a full-grown boll as many as twelve have been found. In any case, however, the hatching of a single larva in a boll results in the destruction of the boll to such an extent that its fiber is useless. Where no serious frost occurs in December, the insects all, or nearly all, reach maturity and enter hibernating quarters, although larvæ have been found on into January at Sharpsburg. Whenever a heavy frost comes

in this month, or before, the observations of last fall show that those insects which have not reached the beetle stage are nearly all killed. From this fact it follows that the insect will probably not prove as injurious in other portions of the cotton belt as it is in southern Texas.

It was found during the latter part of 1895 that the weevil was present in a number of localities in which it was not known by the planters themselves to occur. It is important that every planter who lives in or near the region which we have mapped out should be able to discover the weevil as soon as it makes its appearance in his fields. Where a field is at all badly infested the absence of bloom is an indication of the presence of the insect. In the early part of the season the weevils attack the squares first, and these wilt and drop off. A field may be in full blossom, and as soon as the insect spreads well through it hardly a blossom will be seen. This dropping alone, however, is not a sufficient indication of the weevil's presence. Squares are shed from other causes, but if a sufficient number of fallen squares are cut open the cause will be apparent. The characteristic larva of the weevil will be quite readily recognizable on comparison with the figures which we publish herewith.

FIG. 5.—Late fall boll, showing how beetles hide between boll and involucre.

As stated above, the bolls do not drop. The punctures made by the weevils in feeding, however, are comparatively characteristic, and where a boll is discolored and has begun to crack at the tip the larva or the pupa can be seen without trouble on cutting it open. Late in the season the weevils themselves will be found between the involucre and the boll, as shown in fig. 5, or in their absence the feeding marks and the yellow, granular excrement which collects in the involucre at the base of the boll are excellent indications.

POPULAR NAMES.

In south Texas, among Spanish-speaking people, the insect is generally known as the "picudo," a descriptive name which refers to the snout or beak of the insect. English-speaking planters generally referred to the insect at first as "the sharpshooter," a term which for many years has been applied to any insect which causes through its punctures the shedding of the squares or the rotting of the bolls. As there are several native insects that are commonly called sharpshooters, and which, though injurious, are by no means to be compared with this insect, it becomes necessary to discourage in every way the use of the word sharpshooter as applied to this weevil. This was attempted in the first edition of the circular by illustrating one of the commonest of the insects ordinarily termed sharpshooters, calling attention to the radical differences which exist between it and the weevil under consideration. The adoption of the term "Mexican cotton-boll weevil" for the new pest is recommended. The term sharpshooter is now much less generally applied to the weevil than it was at first. Planters generally now refer to it as the boll weevil, or the Mexican weevil, or the Mexican boll weevil.

PARASITES AND NATURAL ENEMIES.

It is safe to say that little assistance will be derived from the work of natural enemies and parasites upon this insect. Of the former none

of any importance have been found. Several parasites, however, have been found to attack it, and in one or two localities some little good has resulted from their work. They have only been abundant, however, late in the season, after the weevil has completed its damage for the year and at a time when a minimum of good can be accomplished by the destruction of the larva. The majority of the weevils in a given field fail to hibernate successfully, being killed by cold weather or some other cause, so that the work of parasites at this time does not count. Careful estimates, however, show that from 15 to 20 per cent of the weevil larvæ in fallen squares in November, 1895, at Beeville and Kenedy were destroyed by parasites.

REMEDIES.

In considering the matter of remedies it should be understood at the outset that experience has shown that none of the general applications of insecticides are of the slightest value against this species as a means of protecting infested fields. The weevil in its work in growing cotton is thoroughly protected against poisons, breeding as it does within the blossoms and squares. As demonstrated by the experience of the spring of 1896, poisons may, however, be used as a means of destroying overwintered beetles on volunteer cotton. The beetles which have survived the winter collect in the early spring on the first sprouts which appear on old cotton and eat the partially expanded leaves and the tender leaf stems, and at this stage can be poisoned by the application of an arsenical to this new growth. To do this it will be necessary to thoroughly spray the growing tips, and this should be done when volunteer cotton is very small, preferably mere sprouts or bunches of leaves an inch or two in length; later on the growing parts can not be easily reached. With an ordinary knapsack pump a field may be gone over rapidly and the volunteer cotton thoroughly treated, the nozzle being directed at each growing tip. The first application should be made as soon as the volunteer plants sprout, and perhaps repeated two or three times within as many weeks. As ordinarily cultivated, the number of volunteers is small and the time required for the thorough spraying of such plants will not be great. A strong solution should be applied, viz, 1 pound of the poison to 50 gallons of water, because no harm will be done if the volunteer plants are ultimately killed by the poison.

The practicability of this method has been demonstrated, but it has been abundantly shown that the very best system of control of the weevil is in a system of cultivation of cotton, to be later described, which will prevent all possibility of volunteer growth whatever. The poisoning and the other palliative measures relative to volunteer growths are given, therefore, merely as a means of correcting an evil which may result if the cultural system referred to has been neglected. These remarks apply, for instance, to the trap system, which we have hitherto recommended among others. This consists of attracting the earliest beetles to a few cotton plants left at convenient points and protected from winter killing by forced watering, so that they will branch out and acquire buds often in advance of volunteer cotton. From these the beetles may be collected by hand when they are attracted to them by the first warm days, or, preferably, these plants may be poisoned, as already suggested.

The fact that the spring generation develops only upon volunteer cotton has suggested the possibility that the insect will not spread

beyond the region where volunteer cotton will grow in spring, but unfortunately this possibility is by no means absolutely to be relied upon. Nevertheless, the destruction of such volunteer plants as come up in cornfields and in abandoned fields which the previous year were planted to cotton, unless they be systematically poisoned, can not be too strongly recommended, for it is a matter of observation that the shade afforded by the corn or the rank-growing weeds which come up in abandoned fields is especially favorable to the development of the weevils.

While the plants are young, and where labor is as cheap as it is in south Texas, a great deal of good can be accomplished by picking and burning the fallen squares, and if this is done promptly a large number of the insects will be destroyed. It should be done at least twice, at intervals of three weeks, during the period while the plants are small. As soon as the plants begin to branch out, however, this method becomes impracticable, on account of the difficulty of finding the squares on the ground.

The idea of picking the affected bolls during the cotton picking was suggested in the writer's first published account of this insect. It was thought that the affected bolls could be so readily recognized that many thousands of the insects could be destroyed by the cotton pickers by picking these affected bolls and carrying them away in a separate receptacle to be burned. The amount of extra labor involved in this operation, however, would be very considerable, and the affected bolls in many instances are not to be recognized at a glance.

During the past year Mr. Stronhall, of Beeville, has devised a machine for jarring the affected squares and blossoms from young cotton plants and collecting them at the same time. This apparatus has been given a partial demonstration the past season, but was not seen at work by any of the entomologists engaged in the investigation. It is arranged to brush the cotton from both directions vigorously, and the loosened bolls and squares are caught on receiving trays and ultimately burned or otherwise destroyed. The brushes work in opposite directions and strike the cotton plants on either side. It can be adjusted to plants of different ages.

The careful investigation of this weevil during the past two or three years by the Division of Entomology has fully demonstrated the supreme importance of the cultural method of control, to which fact we gave special prominence in our first circular on this insect. There can be no question now that in the proper system of growing cotton a practically complete remedy for the weevil exists. In the first place, it has been established beyond question that the conditions of cultivation which make volunteer growth possible also make the continuance of the weevil inevitable. Of first importance is the early removal of the old cotton in the fall, preferably in November or earlier. This can be done by throwing out the old plants with a plow, root and all, and afterwards raking them together and burning them. This treatment should be followed, as promptly as may be, by deep plowing, say to a depth of 6 or 8 inches. This leaves the field comparatively clean of old cotton stalks, facilitates thorough cultivation the following year, and, at the same time, collects and destroys all of the weevil larvæ and pupæ in the cotton at the time, and also most of the adults. The escaping beetles will be buried by deep plowing, and will not again reach the surface. Few, if any, of them will succeed in hibernating in the absence of the ordinary rubbish in the fields in which they winter. Fields treated in this way have given a practical demonstration of the usefulness of the method.

The greatest danger from the weevil is due to the presence of volunteer cotton, which means early food for the weevils in the spring and abundant means for their overwintering, and the effort made to retain volunteer and get early cotton, or the "first bale," is a very serious menace to cotton culture within the weevil district.

This cultural method, if generally practiced, will undoubtedly prove a perfect remedy for upland cotton, and will vastly reduce weevil damage in the lowlands, where the weevil is more apt to winter, perhaps in adjoining woods or roadside vegetation. The early removal of cotton by the means suggested is especially advised whenever the presence of the weevil shows that the picking of a top crop is problematical. In such instances it would be well to uproot and destroy cotton stalks in September or October, as would have been thoroughly feasible for much of the upland cotton in 1896. If this cultural method can be enforced, either by State legislation or by the cooperation and insistence on the part of landowners that their renters shall carry out the system outlined, the weevil difficulty can undoubtedly in very large measure be overcome.

In connection with the system of fall treatment of the cotton, constant and thorough cultivation of the growing crop as late as possible is of considerable value, and is also what should be done to insure a good yield. With a crossbar to brush the plants many of the blossoms and squares containing weevils will be jarred to the ground and buried, together with those already on the ground, in moist soil, and a large percentage of the material will rot before the contained insects have developed.

It will be greatly to the interest of all growers of cotton in the prolific district lying to the northeast of the region at present infested to urge the passage of an act during the session of 1896–97 which will bring about the enforcement of remedial work in 1897. This act should provide for the appointment of commissioners in each county upon the application of a certain number of the citizens of that county. These commissioners should be empowered to enforce remedial work, to levy penalties, or to have the work done by their own agents, the cost to be assessed upon the property. It will be well to let this law have a wide bearing and not to confine its application to this particular insect, but cover all injurious insects, in case of future emergencies of a similar nature. Such a law should be passed in every State in the Union. Though it might remain inoperative for years, its application would be available in case of any sudden emergency, such as the introduction from a foreign country of a new injurious insect, or the sudden multiplication and spread of any one of our native species.

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Approved:
CHAS. W. DABNEY, Jr.,
Assistant Secretary.

WASHINGTON, D. C., *February 4, 1897.*

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